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Research article

COMPARISON OF L2 AND L5 MEASUREMENTS FOR DIAGNOSING INTESTINAL OBSTRUCTION IN CATS

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Gastrointestinal foreign bodies are a common cause of acute abdominal disease in cats and may result in partial or complete intestinal obstruction with potentially life-threatening consequences. This study aimed to evaluate the diagnostic value of radiographic intestinal measurements, vertebral ratio analysis, and complementary imaging techniques in cats with suspected gastrointestinal foreign bodies. A total of 80 cats of different breeds, ages, and both sexes were included and divided into four groups: 20 with gastrointestinal foreign bodies, 20 healthy controls, 20 with non–foreign body gastrointestinal diseases, and 20 with urinary system diseases. All cats underwent direct abdominal radiography, and measurements were obtained from the duodenum, jejunum, ileum, and colon. Intestinal-to-vertebral ratios were calculated using the lengths of the L2 and L5 vertebrae. In selected cases, contrast radiography and ultrasonography were performed, and hematological and blood gas analyses were evaluated in affected cats. Statistical analysis included ANOVA, nonparametric tests, logistic regression, and ROC curve analysis. Cats with foreign bodies showed significantly increased intestinal diameters ($p< 0.05$). Intestinal-to-vertebral ratios were the strongest predictors, with a jejunal cutoff value of 5.47 mm yielding 84.6% sensitivity and 85.7% specificity. In 35% of cases, small intestinal diameter remained below 12 mm, highlighting limitations of absolute measurements. Ultrasonography improved diagnostic confirmation in equivocal cases. In conclusion, combining radiographic measurements with vertebral ratio analysis improves diagnostic accuracy. Integration of clinical and imaging findings enhances decision-making, reduces unnecessary surgical interventions, and provides a practical diagnostic approach for routine veterinary practice.

Keywords: Feline , Gastrointestinal , Obstruction, Radiography , L2 L5 Vertebrae

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INTRODUCTION

Intestinal obstruction in cats is relatively uncommon at a population level but represents a clinically important and potentially life-threatening condition among cats presenting acute gastrointestinal signs [1-3]. Population-based studies report a low annual prevalence of gastrointestinal foreign bodies—by far the most common cause of mechanical intestinal obstruction in cats—of approximately 0.1–0.2% in primary care settings [4-6]. However, among cats evaluated for vomiting, anorexia, abdominal pain, or gastrointestinal dysfunction, intestinal obstruction accounts for a substantially higher proportion of diagnoses, underscoring its clinical relevance in referral and emergency practice [3,7]. The most frequently reported causes include discrete and linear foreign bodies, intussusception, and intestinal neoplasia, with less common etiologies such as strictures or hernias [4,8,9]. Regardless of etiology, delayed or inaccurate diagnosis of intestinal obstruction may result in bowel ischemia, perforation, septic peritonitis, and increased mortality, highlighting the need for prompt and reliable diagnostic assessment [3,10].

Abdominal radiography remains a cornerstone of the initial diagnostic workup for cats with suspected intestinal obstruction due to its widespread availability, rapid acquisition, and cost-effectiveness [10-13]. Among radiographic findings, small intestinal dilation is considered one of the most informative indicators of mechanical obstruction [9,10]. However, visual assessment of intestinal diameter is inherently subjective and may be influenced by patient size, body condition, degree of luminal gas or fluid accumulation, and radiographic positioning [12-14]. These sources of variability contribute to interobserver inconsistency and may complicate differentiation between mechanical obstruction and non-obstructive causes of ileus in feline patients [9,15,16]. Thus, early CT evaluation is especially important in cases involving duodenal foreign bodies or bowel wall rupture, as these were associated with a higher risk of complications and mortality [17].

To improve objectivity and diagnostic consistency, quantitative radiographic measurement techniques that normalize intestinal diameter to vertebral body dimensions have been developed and incorporated into veterinary imaging practice [10,13]. In cats, normalization of the maximum small intestinal diameter to the height of the second lumbar vertebra (L2) has been proposed as a reliable method for assessing intestinal dilation [9,13]. Previous studies have demonstrated that increasing small intestine–to–L2 ratios are significantly associated with gastrointestinal disease and that higher ratios correlate with an increased likelihood of mechanical intestinal obstruction [9,13]. As a result, L2-normalized measurements have become widely referenced in feline radiographic assessment and are commonly included in diagnostic guidelines and educational resources [12,13].

In contrast, normalization to the fifth lumbar vertebra (L5) has been more extensively studied and applied in canine patients, where it provides a reliable size-adjusted metric for evaluating small intestinal dilation [12,18]. Despite its frequent use in dogs, the diagnostic performance and clinical applicability of L5-based normalization in cats remain essentially unvalidated [13]. Anatomical and proportional differences between feline and canine vertebral columns, as well as species-specific variation in abdominal conformation and intestinal distribution, raise uncertainty regarding whether L5 represents an appropriate or reliable reference landmark in cats [9,13]. At present, there is a lack of comparative data evaluating L2 and L5-normalized measurements within the same feline population, and no consensus exists regarding the optimal vertebral reference for radiographic assessment of intestinal obstruction in this species [13].

A direct comparison of L2 and L5-based intestinal diameter measurements may therefore provide important insights into their relative diagnostic utility and consistency in cats [9,13]. Establishing the most reliable vertebral reference could reduce subjectivity in radiographic interpretation, improve diagnostic accuracy, and contribute to more standardized imaging criteria for feline intestinal obstruction [3,12]. Accordingly, the objective of this study was to perform a comparative evaluation of L2 and L5-normalized small intestinal diameter measurements in cats with suspected intestinal obstruction and to assess their diagnostic performance in distinguishing obstructive from non-obstructive intestinal disease.

MATERIALS AND METHODS

Materials

Eighty cats of different breeds, ages, and sexes presented to the Selçuk University Faculty of Veterinary Medicine Small Animal Hospital with suspected foreign body ingestion, gastrointestinal disease, or urinary system disease were included in this study. The cases were allocated into four groups, with 20 cats in each group.

Group I consisted of cats with a history suggestive of foreign body ingestion and clinical signs such as vomiting, inappetence, and anorexia, in which a gastrointestinal foreign body (linear or non-linear) was confirmed through clinical and diagnostic evaluation (Table 1). Diagnosis of foreign bodies was confirmed by surgery (n=20), ultrasonography (n=18), or contrast radiography (n=17). Group II included cats with gastrointestinal diseases (Table 2), Group III included cats with urinary system diseases (Table 3), and Group IV consisted of healthy cats without gastrointestinal or urinary system disorders (Table 4).

No a priori power analysis was performed, and the sample size was determined based on case availability, which may have limited statistical power.

Radiological metric measurements of Group I were compared with those of the comparison groups. All measurements were performed by a blinded observer.

Table 1. Signalment and clinical history of cats with intestinal foreign bodies. The diagnosis of intestinal foreign bodies was confirmed surgically (Group I).

Cases	Breeds	Age	Gender	Clinical Anamnesis
1	Scottish Mix	1 year	Male	Persistent vomiting and no bowel movements for 3 days.
2	Mix	1 year	Female	No appetite for 6 days, Vomiting, diarrhea, and string under the tongue.
3	Tabby	6 month	Female	Vomiting 5–6 times daily for 2 days.
4	Mix	9 month	Female	Anorexia for 4 days, with vomiting during the first 2 days.
5	Ankara cat	4 month	Female	Intermittent vomiting and anorexia for 18 days.
6	Mix	9 month	Female	No appetite for 5 days, drinking, or defecation, with occasional vomiting.
7	Tabby	1 year	Male	Frequent vomiting for 1 day, with plastic foreign material observed in the vomitus.
8	Tabby	1 year	Female	Persistent vomiting despite antiemetic therapy for 3 days, with absence of defecation.
9	Mix	3 year	Female	History of colonic foreign body removal via laparotomy 1 week ago at another center; re-ingestion of foreign material on postoperative day 4, with anorexia and absence of defecation for 3 days.
10	Tabby	10 month	Male	Vomiting for 2 weeks, with anorexia for the last 24 hours, frequent vomiting, absence of defecation, and a history of pica behavior.
11	Mix	2 year	Female	Foamy vomiting for 4 days despite antiemetic therapy, with absence of defecation.
12	British shorthair	6 month	Male	Vomiting 4–5 times daily despite antiemetic therapy.
13	Tabby	9 month	Female	Weight loss and decreased appetite for 1 month.
14	Tabby	7 month	Male	Hematemesis for 1 day.
15	Blue Point	6,5 month	Male	Vomiting for 1 week.
16	British shorthair	2 month	Female	Continuous vomiting for 1 day.
17	Tabby	6 month	Female	Observed ingestion of a string foreign body.
18	Ankara cat	1 year	Female	Vomiting persisting for 2 months.
19	Tabby	14 year	Female	Lethargy and progressive weight loss for 10 days.
20	British shorthair	7 month	Female	Absence of defecation for 3 days and anorexia.

Table 2. Signalment and clinical history of cats with gastrointestinal disorders (Group II).

Cases	Breeds	Age	Gender	Weight/ kg
1	Blue Point	1 year	Female	4.9
2	Siamese	9 month	Female	3.5
3	Scottish Fold	8 month	Male	3.8
4	Scottish Fold	9 month	Male	4.5
5	Turkish Van	6 month	Female	2.75
6	Blue Point	6 month	Female	3.1
7	Scottish Fold	2 year	Male	3.6
8	Scottish Fold	9 month	Male	3.8
9	Tabby	3 year	Female	3.2
10	Mixed	6 month	Male	3.4
11	Scottish Fold	1 year	Male	3.7
12	Chinchila Persian	5 year	Male	5.1
13	British Shorthair	8 month	Female	4.2
14	Tabby	13 month	Male	3.5
15	British Shorthair	1 year	Male	4.3
16	Scottish Fold	14 month	Male	4.4
17	Mixed	6 month	Male	3.2
18	Exotic Shorthair	4 year	Male	3.2
19	British Shorthair	10 month	Female	4.3
20	Smoked cat	8 month	Male	3.7

Table 3. Signalment and clinical history of cats with urinary system diseases (Group III).

Cases	Breeds	Age	Gender	Weight/ kg
1	Tabby	7 year	Male	4.5
2	Tabby	2 year	Male	3.5
3	British shorthair	10 month	Male	3.7
4	British shorthair	7 month	Male	3.3
5	Tabby	9 month	Male	3.4
6	British shorthair	15 month	Male	4.4
7	Scottish fold	20 month	Male	4.7
8	Scottish fold	1 year	Male	3.9
9	Scottish fold	16 month	Male	4.3
10	British shorthair	14 month	Male	3.5
11	British shorthair	16 month	Male	3.7
12	Tabby	5 year	Male	3.2
13	British shorthair	9 month	Female	4.8
14	Exotic	4 year	Male	3.3
15	British shorthair	13 month	Male	4.3
16	Tabby	2 year	Male	4.8
17	Tabby	2 year	Female	3.1
18	Scottish fold	2 year	Male	5.5
19	Melez	2 year	Male	3.6
20	Scottish fold	4 year	Female	4.5

Table 4. Signalment and clinical history of healthy cats without gastrointestinal or urinary system disease (Group IV).

Cases	Breeds	Age	Gender	Weight/ kg
1	Tabby	10 month	Male	4.2
2	Mixed	9 month	Male	3.8
3	Smoked cat	13 month	Male	3.5
4	Ankara cat	8 month	Male	3.45
5	Smoked cat	7 month	Male	4.5
6	Van	10 month	Male	3.6
7	Tabby	1 year	Male	3.4
8	Tabby	7 year	Female	4.1
9	Tabby	9 month	Male	3.75
10	Tabby	15 month	Female	3.6
11	Tabby	8 month	Male	3.4
12	Tabby	11 month	Female	3.9
13	Persian cat	14 month	Female	3.5
14	Tabby	4 month	Female	2.4
15	Ankara cat	2 year	Male	4.2
16	Persian cat	10 month	Male	3.5
17	British shorthair	6 month	Male	2.7
18	Scottish fold	7 month	Male	3.2
19	Tabby	5 month	Female	2.2
20	Tabby	6 month	Male	2.8

Clinical Examination

For cases presented to the clinic with suspicion of a foreign body, anamnesis information was obtained and examination forms were completed. The duration of vomiting and inappetence was recorded. General condition was assessed by inspection. During abdominal palpation, the degree of pain was recorded using the Feline Grimace Scale. Body temperature was measured. Hydration status and defecation were noted. Cases with gastrointestinal or urinary system problems were referred to the Department of Internal Medicine, where diagnoses were established following detailed examinations.

Direct Radiographic Examination

In all cases, lateral–lateral and ventrodorsal abdominal radiographic images were obtained using a Siemens 48033404 (ITA) X-ray unit. On the radiographs, the integrity of the diaphragm was first evaluated. The liver, stomach, kidneys (right and left), and urinary bladder were identified. Pathological findings (such as hepatomegaly, renal enlargement and irregular structure, urinary bladder dilatation, etc.) were recorded.

The small and large intestines were differentiated based on their diameters. On radiographs, the large intestine was distinguished by being approximately three times wider than the small intestine. Subsequently, radiographic findings were evaluated and recorded with respect to the stomach, segmental small intestinal dilatation (duodenum, jejunum, and ileum), plication, or presence of a foreign body.

To assess the diagnostic effectiveness of intestinal dilatation ratios in foreign body–related intestinal obstructions, measurements of small and large intestinal widths were performed. In healthy cats, the diameter of the colon is 2–3 times greater than that of the small intestine; this relationship was evaluated in diseased cats.

In all cases, dorsoventral narrowest and cranial height measurements of the L2 and L5 vertebrae (Figures 1 and 2) were obtained.

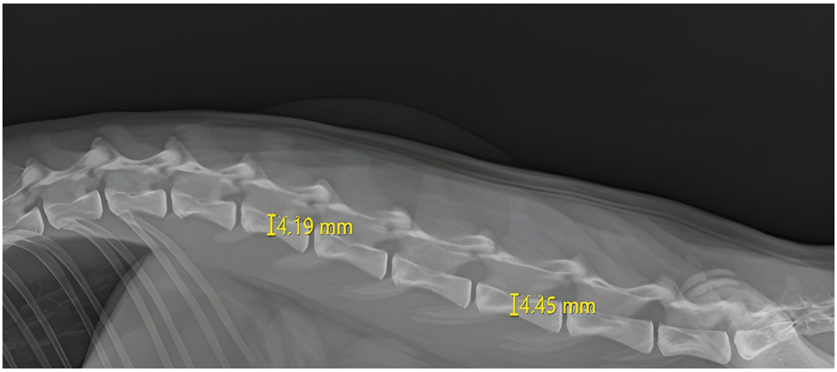

Figure 1. Metric measurement at the narrowest point of the L2 and L5 vertebrae in the dorsoventral direction

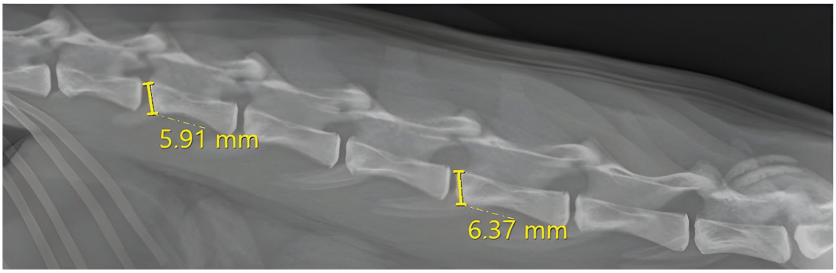

Figure 2. Measurement of the dorso-ventral cranial dimensions of the L2 and L5 vertebrae.

Measurements of the small intestine (duodenum, jejunum, ileum) and large intestine (ascendens colon, transverse colon, descendens colon) were compared with the dorsoventral corpus height of the second lumbar vertebra. When the ratio of intestinal width to vertebral height was 3 or greater, the probability of mechanical obstruction was considered to be greater than 70% [11].

Contrast-Enhanced Radiographic Examination

In cases where the diagnosis was uncertain, contrast-enhanced radiographs were obtained following direct radiography. In the preoperative period, an iodine-containing contrast agent (Omnipaque® (İohexol) Opakim Tıbbi Ürünler Sanayi Ve Ticaret A.Ş.) was administered to cats at a dose of 2.5–3 mL/kg. Radiographs were obtained as a serial study at 5, 15, and 30 minutes, and subsequently at 30-minute intervals. The gastric emptying time of the contrast medium was taken into consideration (1–3 hours), and the findings were interpreted after the passage of the contrast medium into the large intestine was observed.

Ultrasonographic Examination

Ultrasonographic examination was performed in ventrodorsal positions using an Esaote MyLab™ X7VET (Italy) ultrasonography unit. To allow detailed evaluation of the gastrointestinal wall, high-frequency 7.5–10 MHz linear and convex probes were preferred. Foreign bodies with hyperechoic margins that could not be detected radiographically, with or without associated fluid accumulation, were identified ultrasonographically.

Blood Analysis

In cats, 0.5 mL of blood was collected from the brachial vena cephalica into a heparinized syringe and transferred to a Vacufine K3 EDTA tube. Hematological parameters were obtained using a hematology analyzer (MS4E, Austria), and blood gas parameters were measured using a Radiometer blood gas analyzer (ABL90flex, USA) (Figure 2.12). Additionally, 1 mL of blood was collected from the brachial vena cephalica into a non-heparinized syringe and transferred to BD Vacutainer tubes. The samples were centrifuged at 5000 rpm for 5 minutes using a centrifuge (Cence TDZ4-WS, China) to separate the serum. All values were recorded on the blood analysis form. The following parameters were evaluated: pH, PO_2, K, Na, Cl, lactate, WBC, Hb, HCO_3^-, and hematocrit.

Statistical Analysis

Data Analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26.0. Demographic data of the four cat groups (cats with foreign bodies, healthy cats, cats with gastrointestinal diseases, and cats with urinary system diseases) were expressed as numbers and percentages. Anatomical measurements were presented as mean, standard deviation, median, minimum, and maximum values. The normality of distribution for anatomical measurements was assessed based on skewness and kurtosis values. Age, body weight, maximum colonic diameter, the ratio of maximum colonic diameter to maximum small intestinal diameter, corpus height of L5, jejunum, and ileum measurements were found to comply with normal distribution criteria, except for descending colon measurements. The reference range for normal distribution was accepted as ±1.96. The Chi-square test was used to compare demographic data among the four cat groups (cats with foreign bodies, healthy cats, cats with gastrointestinal diseases, and cats with urinary system diseases). One-way ANOVA or Kruskal–Wallis H tests were used to compare anatomical measurements among the four groups. In groups where statistically significant differences were detected, Post Hoc tests were applied to identify the source of the differences. Pearson or Spearman correlation analyses were used to evaluate the relationships between the presence of foreign bodies, gastrointestinal or urinary disease status, and various parameters in cats. Correlation coefficients were interpreted as follows: 0.00–0.30 indicated a weak correlation, 0.30–0.70 a moderate correlation, and 0.70–1.00 a strong correlation [19].

Logistic regression and ROC analyses were performed to estimate the probability of foreign body presence, gastrointestinal disease, or urinary system disease based on various measured parameters. Throughout the study, significance levels of 0.05 and 0.01 were considered [19].

RESULTS

Anamnesis and Clinical Examination

The distribution of the 80 cats included in the study group according to breed, age, and sex was evaluated. The distributions of breed, age, sex, and body weight were compared among the groups in the study. Although differences in breed distribution were observed among the groups, these differences were not statistically significant ($p > 0.05$). The majority of cases consisted of cats aged 0–12 months, and foreign body cases were predominantly observed in this age group. A statistically significant difference was detected among the groups in terms of mean age ($p < 0.05$), with cats diagnosed with urinary system disease having a higher mean age compared to the other groups. Regarding sex distribution, male cats were more prevalent in all groups; however, no statistically significant difference was found among the groups ($p > 0.05$). Analysis of mean body weight revealed a statistically significant difference among the groups ($p < 0.05$), with cats suffering from urinary system disease having higher mean body weights.

Blood Analysis Findings

In Group 1 hemogram and blood gas values were evaluated preoperatively. An increase in WBC count was observed in 24% of the cases. Hematocrit levels were elevated in 90% of the cases, while hemoglobin levels were increased in 55%. Blood pH was increased (alkalosis) in 55% of the cases, whereas a decrease (acidosis) was detected in 10% of the cases (Cases 5 and 20). A decrease in HCO_3^- (bicarbonate) levels was observed in 65% of the cases, while 20% showed an increase. Potassium (K) levels were decreased in 55% of the cases.

A marked increase in lactate levels was detected in 90% of the cases. Sodium (Na) levels were elevated in 40% of the cases, while chloride (Cl) levels were increased in 45%. The remaining cases were within normal reference ranges. Partial oxygen pressure (PO_2) was below 40 mmHg in 35% of the cases.

Case 5 exhibited a severe decrease in pH accompanied by a markedly elevated lactate level and died 6 hours postoperatively. In Case 6, a repeat hemogram was performed on postoperative day 10. The diagnosis of panleukopenia was confirmed. When mean blood values were evaluated, lactate was the only parameter outside the reference range, with values ranging from 1.2 mmol/L to 10.4 mmol/L.

Direct Radiographic Examination Findings

In all cases, dorsoventral height measurements of the L2 and L5 vertebrae at the narrowest point (Figure 3) and at the cranial aspect (articulation with L1 and L4, respectively) (Figure 3) were obtained. Additionally, width measurements of the small intestine (duodenum, jejunum, ileum) and large intestine (ascending colon, transverse colon, descending colon) were performed (Table 5) and compared among the groups.

The maximum small intestinal diameter was ratioed to the cranial and narrowest measurements of the L2 and L5 vertebrae, and intergroup differences were evaluated. Furthermore, the widths of the anatomical intestinal segments were subjectively assessed and analyzed in terms of intergroup differences.

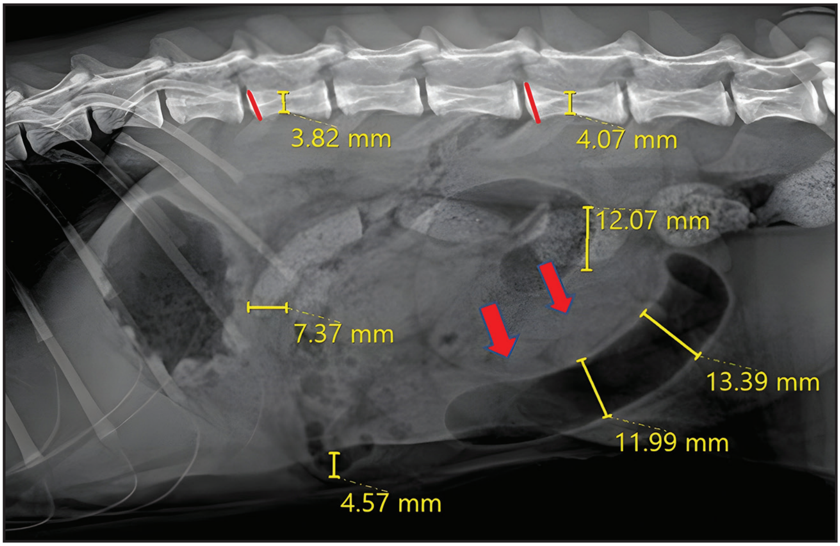

Figure 3. Group 1, Case 12, British, 6 months old, male. Latero and lateral abdominal radiograph. The measurement point where L2 and L5 are narrowest in the dorso-ventral direction (red-yellow lines).

Table 5. Measurements of the dorso-ventral epiphysis and height at the narrowest point of the L2 and L5 vertebrae (Descriptive statistics).

	Group	Mean	Minimum	Maximum
Corpus L2	1	4.14	3.43	5.34
	2	4.52	3.43	5.72
	3	4.64	3.68	5.34
	4	4.77	3.94	5.59
Corpus L5	1	4.18	3.30	5.59
	2	4.33	3.31	5.43
	3	4.64	3.43	6.67
	4	4.68	3.68	7.07
Cranial-L2	1	5.32	4.45	6.48
	2	5.56	4.66	6.68
	3	5.65	5.14	6.19
	4	5.81	4.32	6.87
Cranial-L5	1	5.83	4.83	6.85
	2	5.88	5.02	7.17
	3	5.95	5.51	7.15
	4	6.08	5.08	7.24

The mean of corpus L2 measurement was 4.51. The mean of corpus L5 measurement was 4.18 in the foreign body group, 4.68 in the healthy group, 4.32 in the gastrointestinal disease group, and 4.64 in the urinary system disease group. The mean cranial L2 measurement was 5.32 in the foreign body group, 5.81 in the healthy group, 5.56 in the gastrointestinal disease group, and 5.65 in the urinary system disease group.

The mean cranial L5 measurement was 5.83 in the foreign body group, 6.09 in the healthy group, 5.88 in the gastrointestinal disease group, and 5.95 in the urinary system disease group.

No statistically significant difference was found between the cranial and corpus dorsoventral height measurements of the L2 and L5 vertebrae ($p > 0.05$)

The duodenum could be identified in 28 of the 80 cats (35%). In Group 1, the duodenum could not be identified in only 3 of the 20 cases (15%). In Group 4 (healthy cats), the duodenum could not be identified in any case. In Group 2, the duodenum was identified in 50% of the cases, whereas in Group 3, it was identified in only one case (5%).

The mean duodenal diameter was 13.35 mm in the foreign body group, 7.81 mm in the gastrointestinal disease group, and 7.86 mm in the urinary system disease group. When all cases in which the duodenum was measurable were evaluated (n = 28), the overall mean duodenal diameter was 11.22 mm, with minimum and maximum values of 5.16 mm and 23.10 mm, respectively. Based on these data, a statistically significant difference was observed among the four cat groups in terms of mean duodenal diameter ($p < 0.05$). The mean duodenal diameter in cats with foreign bodies was higher than that in cats with gastrointestinal and urinary system diseases (Table 6).

Table 6. Analysis of intestinal and colon segment measurements in four different groups of cats.

Parameters	Foreign body (a) *(n:20)* *Ort.±S.S (Min.-Max.)*	Healty(b) *(n:20)* *Ort.±S.S (Min.-Max.)*	GIS(c) *(n:20)* *Ort.±S.S (Min.-Max.)*	Urinary(d) *(n:20)* *Ort.±S.S (Min.-Max.)*	*P*	
Duodenum^F	13.35 ± 4.35 12.21 (6.65-23.16)	±	7.81 ± 2.5 7.4 (5.16-13.69)	7.86 ± 0.00 7.86 (7.86-7.86)	**0.004****	**a>c,d**
Jejenum^H	8.16 ± 3.54 7.6 (2.82-16.92)	4.3 ± 1.18 4.15 (2.22-6.99)	6.18 ± 2.23 5.6 (4.17-11.81)	5.56 ± 1.6 5.58 (2.81-8.85)	**0.000****	**a>c,d>b**
İleum^H	10.36 ± 3.83 10.77 (5.77-19.72)	5.92 ± 1.77 5.92 (2.43-9.12)	8.88 ± 2.87 8.6 (4.95-18.09)	9.26 ± 3.31 8.79 (5.54-19.26)	**0.000****	**b<a,c,d**
Colon ascendens^F	12.01 ± 2.24 11.9 (7.07-16.71)	13.04 ± 3.40 11.84 (7.62-20.83)	14.23 ± 5.00 14.24 (6.99-21.85)	15.4 ± 3.95 14.61 (9.16-24.26)	**0.047***	**d>a**
Colon transversus^F	13.56 ± 3.29 13.51 (7.37-19.23)	15.34 ± 3.73 14.95 (9.67-22.99)	15.01 ± 3.63 16.71 (8.44-20.34)	15.33 ± 4.05 15.65 (8.89-23.62)	**0.374**	**–**
Colon decendens^H	13.17 ± 2.26 12.96 (9.9-18.17)	14.76 ± 4.00 14.68 (6.02-20.57)	14.54 ± 3.66 15.11 (4.44-18.92)	16.11 ± 4.64 15.05 (10.06-31.46)	0.078	

*****$p<0,05$, ******$p<0,01$, χ^2**:** Chi-square test (Categorical data), **F:** One Way ANOVA Testi, **H:** Kruskal Wallis H Test.

The jejunum was identified in 19 cases in Groups 1, 2, and 3, and in 18 cases in Group 4 (Tables 5). The mean jejunal diameters for Groups 1 through 4 were 8.16 mm, 6.18 mm, 5.56 mm, and 4.30 mm, respectively, with an overall mean of 5.71 mm. Accordingly, a statistically significant difference was found among the four groups regarding jejunal diameter measurements ($p < 0.05$). The mean jejunal diameter in the foreign body group was higher than those in the gastrointestinal and urinary system disease groups. Furthermore, the mean jejunal diameter in the gastrointestinal and urinary system disease groups was higher than that in the healthy group (Table 6).

The ileum was identified in 17, 19, 16, and 15 cases in Groups 1, 2, 3, and 4, respectively (Tables 6). The mean ileal diameters were 10.36 mm, 8.88 mm, 9.26 mm, and 5.92 mm, respectively. Based on these findings, a statistically significant difference was detected among the four cat groups in terms of mean ileal diameter ($p < 0.05$). The mean ileal diameter in the healthy group was lower than those in the foreign body, gastrointestinal disease, and urinary system disease groups.

The mean ascending colon diameter was 12.01 mm in the foreign body group, 13.04 mm in the healthy group, 14.23 mm in the gastrointestinal disease group, and 15.40 mm in the urinary system disease group. These results demonstrated a statistically significant difference among the four groups with respect to ascending colon diameter ($p < 0.05$). The mean ascending colon diameter in the urinary system disease group was higher than that in the foreign body group (Table 6).

The mean transverse colon diameter was 13.56 mm in the foreign body group, 15.34 mm in the healthy group, 15.01 mm in the gastrointestinal disease group, and 15.33 mm in the urinary system disease group. No statistically significant difference was observed among the four groups in terms of transverse colon diameter ($p > 0.05$) (Table 6).

The mean descending colon diameter was 13.17 mm in the foreign body group, 14.76 mm in the healthy group, 14.54 mm in the gastrointestinal disease group, and 16.11 mm in the urinary system disease group. Similarly, no statistically significant difference was found among the four groups with respect to descending colon diameter ($p > 0.05$) (Table 6).

The ratio of maximum small intestinal diameter to L2 (corpus) height was 3.39 in the foreign body group, 1.09 in the healthy group, 2.08 in the gastrointestinal disease group, and 1.77 in the urinary system disease group. Based on these data, a statistically significant difference was observed among the four cat groups regarding the maximum small intestinal diameter/L2 (corpus) ratio ($p < 0.05$). The highest ratios were recorded in the foreign body group, whereas the lowest ratios were observed in the healthy group (Table 7).

Table 7. An analysis of parameters associated with the maximum small intestine value in four different groups of cats.

Variables	Foreign body[a] (n:20) Ort.±S.S (Min.-Max.)	HEALTY[b] (n:20) Ort.±S.S (Min.-Max.)	GIS[c] (n:20) Ort.±S.S (Min.-Max.)	Urinary[d] (n:20) Ort.±S.S (Min.-Max.)	P	
Maximum small intestine diameter /L2 (corpus)[F]	3.39 ± 1.2 3.28 (1.44-6.18)	1.09 ± 0.4 1.18 (0-1.71)	2.08 ± 0.75 1.84 (1.22-4.07)	1.77 ± 0.64 1.7 (0.58-3.61)	**0.000****	**a>c,d>b**
Maximum small intestine diameter /L2 (cranial)[F]	2.63 ± 0.93 2.32 (1.11-4.39)	0.91 ± 0.36 0.95 (0-1.56)	1.67 ± 0.53 1.54 (0.84-3.24)	1.47 ± 0.6 1.37 (0.48-3.34)	**0.000****	**a>c,d>b**
Maximum small intestine diameter /L5 (corpus)[F]	3.33 ± 1.11 3.28 (1.42-5.69)	1.12 ± 0.43 1.15 (0-1.84)	2.16 ± 0.73 1.96 (1.15-4.17)	1.79 ± 0.68 1.65 (0.61-3.78)	**0.000****	**a>c,d>b**
Maximum small intestine diameter /L5 (cranial)[F]	2.38 ± 0.78 2.25 (0.96-3.88)	0.87 ± 0.34 0.92 80-1.49)	1.58 ± 0.52 1.41 (0.87-3.16)	1.39 ± 0.55 1.25 (0.48-3.03)	**0.000****	**a>c,d>b**
Maximum colon diameter /L2 cranial[F]	2.8 ± 0.43 2.82 (1.92-3.42)	2.83 ± 0.64 2.92 (1.92-4.37)	3.09 ± 0.79 3.32 (1.42-4.25)	3.25 ± 0.75 3.15 (1.96-5.11)	0.109	–

*****p<0,05, ******p<0,01,**χ^2:** Chi-square test (Categorical data), **F:** One Way ANOVA Testi

The ratio of maximum small intestinal diameter to L5 (corpus) height was 3.33 in the foreign body group, 1.12 in the healthy group, 2.16 in the gastrointestinal disease group, and 1.79 in the urinary system disease group. Accordingly, a statistically significant difference was found among the four groups with respect to the maximum small intestinal diameter/L5 (corpus) ratio ($p < 0.05$). The ratios were highest in cats with foreign bodies and lowest in healthy cats (Table 7).

The ratio of maximum small intestinal diameter to L2 (cranial) height was 2.63 in the foreign body group, 0.91 in the healthy group, 1.67 in the gastrointestinal disease group, and 1.47 in the urinary system disease group. These results demonstrated a statistically significant difference among the four cat groups in terms of the maximum small intestinal diameter/L2 (cranial) ratio ($p < 0.05$). The highest ratios were observed in the foreign body group, while the lowest ratios were recorded in the healthy group (Table 7).

The ratio of maximum small intestinal diameter to L5 (cranial) height was 2.38 in the foreign body group, 0.87 in the healthy group, 1.58 in the gastrointestinal disease group, and 1.39 in the urinary system disease group. Based on these data, a statistically significant difference was found among the four cat groups regarding the maximum small intestinal diameter/L5 (cranial) ratio ($p < 0.05$). The ratios were highest in the foreign body group and lowest in the healthy group (Table 7).

The ratio of maximum colonic diameter to L2 cranial height was 2.80 in the foreign body group, 2.83 in the healthy group, 3.09 in the gastrointestinal disease group, and 3.25 in the urinary system disease group. Based on these findings, no statistically significant difference was observed among the four cat groups with respect to the maximum colonic diameter/L2 cranial ratio ($p > 0.05$) (Table 7).

Findings of Contrast-Enhanced Radiographic Examination

Contrast-enhanced radiography was performed in Group 1. Following administration of the contrast medium, gastrointestinal transit times were evaluated. For this purpose, the expected gastric emptying time in healthy cases was 1–2 hours; the filling time of the duodenum was 5–10 minutes; the jejunum, 30–45 minutes; the ileum, approximately 60 minutes; the ascending colon, around 60 minutes; and the descending colon, 2–3 hours.

Ultrasonographic Examination Findings

In Group 1 cases with foreign body–related obstruction, the diagnosis was established using ultrasonography.

In cats in the foreign body group, foreign bodies were most frequently removed from the jejunum (n = 10), followed by the ileum (n = 2), proximal duodenum (n = 2), the pylorus–ileum region (n = 1), foreign bodies extending from beneath the tongue to the ileum (n = 4), and from beneath the tongue to the colon (n = 1).

In some cases, complete or partial linear obstruction was identified, whereas in others, complete obstruction caused by discrete foreign bodies was observed. Complete obstruction due to discrete foreign bodies was detected in 9 of the 20 cases. The removed foreign bodies predominantly consisted of household and plastic materials.

DISCUSSION

Gastrointestinal foreign bodies represent one of the most common causes of emergency presentation in small animal practice and may result in partial or complete intestinal obstruction in both cats and dogs [5,20-22]. In cats, however, the diagnosis of intestinal obstruction is often more challenging than in dogs due to the frequent radiolucent nature of ingested materials, the tendency for partial or linear obstructions, and the presence of nonspecific clinical signs. Consequently, reliance solely on subjective radiographic interpretation may lead to delayed or inaccurate diagnosis. In recent years, the importance of objective, reproducible, and quantitative radiographic parameters in the evaluation of feline intestinal obstruction has been increasingly emphasized [11,23].

Sex distribution did not differ significantly among the study groups, indicating that sex was unlikely to act as a confounding factor for radiographic measurements.

Although breed distribution differed significantly, this finding may reflect differences in environmental exposure, owner management practices, and access to household materials rather than a true breed predisposition. Mean ages were relatively comparable between groups, minimizing the potential impact of growth-related skeletal variations on vertebral measurements.

Complete intestinal obstructions are known to produce more severe clinical signs and metabolic disturbances than partial obstructions [5,24]. In agreement with previous reports, cats with complete obstruction in the present study exhibited more pronounced electrolyte imbalances and significantly elevated blood lactate concentrations. Hyperlactatemia has been associated with tissue hypoperfusion, hypoxia, and impaired hepatic clearance and is considered a valuable indicator of disease severity and prognosis [25,26]. The markedly higher lactate levels observed in cats with complete obstruction, particularly with increasing duration of clinical signs, support the use of lactate as an objective biomarker reflecting obstruction severity rather than merely the presence of gastrointestinal disease [27,28].

Radiographic identification of the duodenum in cats has been reported to be uncommon [11]. Noted that the duodenum could not be identified radiographically in approximately 90% of examined cats, largely due to superimposition with adjacent jejunal loops. In contrast, the present study demonstrated that the duodenum was radiographically identifiable in 35% of all cats and in 85% of cats with gastrointestinal foreign bodies, whereas it was not visualized in any healthy cat, consistent with previous reports indicating that normal small intestinal segments are typically not distinguishable unless distended or affected by pathology [13]. Moreover, duodenal diameter was significantly greater in cats with foreign bodies than in cats with gastrointestinal or urinary disorders. These findings suggest that radiographic visualization and dilation of the duodenum may serve as a strong indicator of underlying gastrointestinal pathology, particularly mechanical obstruction, as intestinal dilation is a well-recognized feature of obstructive disease [13,29]. To the authors' knowledge, quantitative radiographic assessment of duodenal diameter in cats has not been previously reported, underscoring the novelty of this observation.

Jejunal and ileal diameters were significantly increased in cats with foreign bodies compared with all other groups. The jejunum, which represented the most frequent site of foreign body localization in this study, showed the highest diagnostic performance, with a cutoff value of 5.47 mm providing a balanced sensitivity and specificity. Previous studies in cats have largely relied on subjective assessment of intestinal dilation, with limited quantitative data available [11,30,31]. The present findings demonstrate that segment-specific measurements offer substantial diagnostic value and allow more precise differentiation between obstructive and non-obstructive conditions.

Historically, the normal small intestinal diameter in cats has been reported to be approximately less than 10–12 mm on radiographic evaluation [13]. However, in the present study, 35% of cats with confirmed foreign bodies exhibited a maximum small intestinal diameter below this threshold. This observation challenges the reliability of the "12 mm rule" as an absolute diagnostic criterion and highlights the limitations of relying solely on maximum diameter measurements. Previous studies have shown that intestinal dilation may be minimal or absent in early or partial obstruction and in cases involving linear foreign bodies [32,33]. Factors such as early-stage obstruction, partial or linear foreign bodies, short clinical duration, and patient-related variables may all limit the degree of intestinal dilation. These findings emphasize the importance of interpreting absolute measurements in conjunction with vertebral ratios and segment-specific analysis [13].

Vertebral ratio assessment has been proposed as a mean of normalizing intestinal measurements to patient size and conformation [11,23]. In the present study, cranial heights of L2 and L5 did not differ significantly between groups, whereas corpus heights were influenced by age and body size. This finding suggests that cranial vertebral measurements may provide a more stable reference, particularly in young cats. An intestinal diameter-to-L2 ratio of $\geq$2.38 was strongly associated with the presence of a foreign body, while values $\geq$2.70 were suggestive of surgical obstruction, offering practical thresholds for clinical decision-making.

Colonic measurements were generally less discriminatory among groups, consistent with previous observations that colonic diameter is highly variable and influenced by factors such as fecal content and hydration status [13,34]. However, the ratio of maximum colonic diameter to maximum small intestinal diameter was significantly lower in cats with foreign bodies, indicating that relative intestinal-to-colonic relationships may contribute to diagnostic interpretation, as comparative radiographic assessment is often more informative than isolated measurements. Increased ascending colon diameter observed in cats with urinary system disease likely reflects secondary abdominal or functional changes rather than primary gastrointestinal pathology.

Ultrasonography played a critical complementary role in this study, particularly in cases where radiographic findings were inconclusive. Although radiography correctly identified foreign bodies in 85% of cases, ultrasonography provided definitive diagnosis in all remaining cases. These results are consistent with previous reports demonstrating the superior sensitivity of ultrasonography, particularly for detecting radiolucent and linear foreign bodies [21,35,36]. Together, these findings support the concept that radiography and ultrasonography should be regarded as complementary rather than competing imaging modalities in the diagnostic approach to feline intestinal obstruction.

In conclusion, this study demonstrates that segment-specific intestinal measurements, vertebral ratio analysis, and radiographic visualization of the duodenum provide valuable adjunctive tools for the diagnosis of gastrointestinal foreign bodies in cats. These findings challenge the traditional reliance on absolute diameter thresholds and introduce clinically applicable cutoff values that may improve diagnostic confidence and support more informed therapeutic decision-making. Ultrasonography remains an indispensable complementary modality, particularly in cases involving radiolucent or linear foreign bodies. Collectively, these results contribute novel quantitative data to the existing literature and support a more objective, measurement-based approach to the radiographic evaluation of feline intestinal obstruction.

From a clinical perspective, the identification of segment-specific intestinal dilation—particularly involving the jejunum and duodenum—combined with vertebral ratio analysis, enables a more standardized and objective interpretation of abdominal radiographs. The proposed cutoff values for intestinal diameter and intestinal-to-vertebral ratios may facilitate earlier recognition of obstruction and aid clinical decision-making. Importantly, the observation that foreign bodies may be present even when intestinal diameters remain below traditionally accepted thresholds highlights the limitations of relying solely on absolute measurements. When integrated with ultrasonographic findings, these parameters may support a structured, stepwise diagnostic approach in cats presenting nonspecific gastrointestinal signs. Notably, the use of cranial vertebral body measurements appears to provide a more stable reference compared with vertebral corpus measurements, particularly in younger animals.

Several limitations should be acknowledged. The relatively small sample size may limit the generalizability of the proposed cutoff values, and larger multicenter studies are needed for validation. Radiographic measurements were obtained from static images, and potential variability related to positioning, image quality, and observer-dependent interpretation cannot be excluded. In addition, the predominance of young cats may have influenced vertebral measurements due to ongoing skeletal development. The heterogeneity of the gastrointestinal disease group and differences in diagnostic confirmation methods across groups may have affected the comparability of findings. Finally, contrast radiography was performed only in the foreign body group, introducing potential diagnostic verification bias. Despite these limitations, the consistent associations observed between metric parameters and confirmed obstruction support the robustness of the findings.

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Authors' contributions

YT contributed to the conceptualization and methodology of the study, conducted the formal analysis and investigation, prepared the original draft of the manuscript, and participated in reviewing and editing the manuscript. MA acquired the funding for the study and contributed to reviewing and editing the manuscript.

Ethics approval and consent to participate

This study was approved by the Selçuk University Faculty of Veterinary Medicine Experimental Animals Production and Research Center Ethics Committee (SÜVDAMEK; approval date: 10.03.2023, meeting no. 2023/02, decision no. 2023/14). Written informed consent was obtained from all animal owners prior to inclusion in the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets used during the current study are available from the corresponding author upon reasonable request.

Declaration of competing interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of informed consent

The owner understood procedure and agreed that results related to investigation or treatment of their companion animals, could be published in Scientific Journal Acta Veterinaria-Beograd.

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REFERENCES

1. Hall JA, Willard MD, Diseases of the small intestine. In: Ettinger SJ, Feldman EC (eds), Textbook of Veterinary Internal Medicine. 8th ed. 2013. Elsevier.
2. Kan T, Hess RS, Clarke DL: Clinical findings and patient outcomes following surgical treatment of chronic gastrointestinal foreign body obstructions in dogs and cats: 72 cases (2010-2020). Can J Vet Res 2022, 86(4):311-315.
3. Fossum TW, 2019. Small Animal Surgery. 5th ed. Elsevier.

4. Parlak K, Akyol ET, Uzunlu EO, Zamirbekova N, Boran Çayırlı ÜF, Arıcan, M: Gastrointestinal linear foreign bodies in cats: A retrospective study of 12 cases. J Adv VetBio Sci Tech 2022, 7(2):233-241.
5. Hayes G: Gastrointestinal foreign bodies in dogs and cats: a retrospective study of 208 cases. J Small Anim Pract 2009, 50(11):576-583.
6. Miller AK, Regier PJ, Ham KM, Case JB, Fisher KJ, Rogers JM, Colee JC: Linear and discrete foreign body small intestinal obstruction outcomes, complication risk factors, and single incision red rubber catheter technique success in cats. Vet Surg 2024, 53(7):1256-1265.
7. Bebchuk TN: Feline gastrointestinal foreign bodies. Vet Clin North Am Small Anim Pract 2002, 32(4):861-880.
8. Aronson LR, Monnet E, Fox PR: Clinical signs and complications associated with intestinal obstruction in cats and dogs. Vet Clin North Am Small Anim Pract 2000, 30:95-110.
9. Dennis R, Kirberger RM, Barr F, Wrigley R: Handbook of Small Animal Radiology and Ultrasound Techniques. 2010, Elsevier.
10. Burk RL, Feeney DA: Small Animal Radiology and Ultrasonography. 3rd ed. 2003, Saunders.
11. Adams WM, Sisterman LA, Klauer JM, Kirby BM, Lin TL: Association of intestinal disorders in cats with findings of abdominal radiography. J Am Vet Med Assoc 2010, 236(8):880-886.
12. Kealy JK, McAllister H, Graham JP: Diagnostic Radiology and Ultrasonography of the Dog and Cat. 5th ed. 2011, Elsevier.
13. Thrall DE: Textbook of Veterinary Diagnostic Radiology. 7th ed. 2018, Elsevier.
14. Ko K, Mann F: Iodinated contrast agents in small animal gastrointestinal imaging. Vet Radiol Ultrasound 2014, 55:135-142.
15. Riedesel DH: Feline gastrointestinal obstruction: imaging findings. Vet Radiol Ultrasound 2007, 48:150-157.
16. Elser PJ, Biller DS, Trepanier LA: Radiographic evaluation of small intestinal obstruction in cats. Vet Radiol Ultrasound 2020, 61(2):229-237.
17. Koo J, Eom K, Kim J, Jeong J, Yoon H, Lee M, Park J, Cho J: Computed Tomographic Features of Bezoars and Other Gastrointestinal Foreign Bodies in Dogs and Cats: A Comparative Analysis. Animals 2025, 15(9):1260.
18. Goggin JM, Biller DS, Debey BM: Radiographic evaluation of small intestinal obstruction in dogs. Vet Radiol Ultrasound 2000, 41:315-321.
19. Büyüköztürk Ş: Veri Analizi El Kitabı: İstatistik, Araştırma Deseni ve SPSS Uygulamaları. 2020, Pegem Akademi.
20. MacPhail CM: Fluid, electrolyte, and acid-base disorders in gastrointestinal obstruction. Vet Clin North Am Small Anim Pract 2002, 32:125-138.
21. Tyrrell KL, Beck KA: Imaging and clinical features of feline intestinal obstruction. Vet Radiol Ultrasound 2006, 47:518-526.
22. Basher AWP, Fowler JD: Conservative versus surgical management of gastrointestinal linear foreign bodies in the cat. Vet Surg 1987, 16:135-138.
23. Graham JP, Kealy JK, McAllister H: Diagnostic imaging of feline intestinal obstruction. Vet Radiol Ultrasound 1998, 39:120-128.
24. Papazoglou L, Patikas M, Rallis T: Intestinal foreign bodies in dogs and cats. Compend Contin Educ Vet 2003, 25:830-843.

25. Fall P, Szerlip H: Lactic acidosis in critical illness. Crit Care Clin 2005, 21:171-185.
26. Dugdale AH: Clinical relevance of lactate measurement in veterinary patients. Vet Clin North Am Small Anim Pract 2010, 40:1011-1023.
27. Gilday C, Guieu L: Prognostic value of lactate in cats presented in respiratory distress to the emergency room. Front Vet Sci 2022, 9:918029.
28. Redavid LA, Sharp CR, Mitchell MA, Beckel NF: Plasma lactate measurements in healthy cats. J Vet Emerg Crit Care 2012, 22:580-587.
29. Power HS, Diamond MM: Clinical and diagnostic findings in feline gastrointestinal obstruction. Vet Rec 2021, 189:322-330.
30. Morgan JP: Radiographic evaluation of normal feline intestines. J Am Vet Med Assoc 1981, 179:1007-1010.
31. Weichselbaum RC, Duerr FM, Roberts GD: Feline small intestine: radiographic measurements. Vet Radiol Ultrasound 1994, 35:85-90.
32. Case LP, Carey DP, Hirakawa DA, Daristotle L: Canine and Feline Nutrition: A Resource for Companion Animal Professionals. 1997, Mosby.
33. Gollnick HR, Schmiedt CW, Wallace ML, Sutherland BJ, Grimes JA: Retrospective evaluation of surgical treatment of linear and discrete gastrointestinal foreign bodies in cats: 2009-2021. J Feline Med Surg 2023, 25(6):1098612X231178140.
34. Washabau RJ: Gastrointestinal motility disorders and gastrointestinal prokinetic therapy. Vet Clin North Am Small Anim Pract 2003, 33(5):1007-1028.
35. Tidwell AS, Penninck D: Ultrasonographic diagnosis of feline gastrointestinal obstruction. Vet Radiol Ultrasound 1992, 33:127-132.
36. Sharma A, Thompson MS, Scrivani PV, Dykes NL, Yeager AE, Freer SR, Erb HN: Comparison of radiography and ultrasonography for diagnosing small-intestinal mechanical obstruction in vomiting dogs. Vet Radiol Ultrasound 2011, 52(3):248-255.

POREĐENJE MERENJA L2 I L5 U CILJU DIJAGNOSTIKOVANJA CREVNE OPSTRUKCIJE KOD MAČAKA

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Gastrointestinalna strana tela su čest uzrok akutnih abdominalnih bolesti kod mačaka i mogu dovesti do delimične ili potpune crevne opstrukcije sa potencijalno opasnim po život posledicama. Cilj ove studije bio je da se proceni dijagnostička vrednost radiografskih merenja creva, analize odnosa pršljenova i komplementarnih tehnika snimanja kod mačaka sa sumnjom na gastrointestinalna strana tela. Ukupno 80 mačaka različitih rasa, uzrasta i oba pola je uključeno i podeljeno u četiri grupe: 20 sa gastrointestinalnim stranim telima, 20 zdravih kontrola, 20 sa gastrointestinalnim bolestima koje nisu izazvane stranim telima i 20 sa bolestima urinarnog sistema. Sve mačke su podvrgnute direktnoj abdominalnoj radiografiji, a merenja su dobijena iz duodenuma, jejunuma, ileuma i debelog creva. Odnosi creva i pršljenova izračunati su korišćenjem dužine pršljenova L2 i L5. U odabranim slučajevima, urađena je kontrastna radiografija i ultrazvuk, a kod obolelih mačaka su procenjeni rezultati hematoloških i analiza gasova u krvi. Statistička analiza je obuhvatala ANOVA, neparametrijske testove, logističku regresiju i analizu ROC krive. Mačke sa stranim telom pokazale su značajno povećane prečnika creva (p< 0,05). Odnosi creva i pršljenova bili su najjači prediktori, sa graničnom vrednošću jejunuma od 5,47 mm, što daje osetljivost od 84,6% i specifičnost od 85,7%. U 35% slučajeva, prečnik tankog creva je ostao ispod 12 mm, što ističe ograničenja apsolutnih merenja. Ultrasonografija je poboljšala dijagnostičku potvrdu u dvosmislenim slučajevima. Zaključno, kombinovanje radiografskih merenja sa analizom odnosa pršljenova poboljšava dijagnostičku tačnost. Integracija kliničkih i slikovnih nalaza poboljšava donošenje odluka, smanjuje nepotrebne hirurške intervencije i pruža praktičan dijagnostički pristup za rutinsku veterinarsku praksu.